4. the absolute value of a cosine: $|H(e^{j2\pi f})| \propto |\cos(\pi f N)|$. In this way, not only can the fundamental but also its first few harmonics be removed. Select the parameter N and the sampling rate so that the frequencies at which the cosine equals zero correspond to 60 Hz and its odd harmonics through the fifth.
5. Find the difference equation that defines this filter.

Problem 5.29: Digital AM Receiver

Thinking that digital implementations are always better, our clever engineer wants to design a digital AM receiver. The receiver would bandpass the received signal, pass the result through an A/D converter, perform all the demodulation with digital signal processing systems, and end with a D/A converter to produce the analog message signal. Assume in this problem that the carrier frequency is always a large even multiple of the message signal's bandwidth W.

1. What is the smallest sampling rate that would be needed?
2. Show the block diagram of the least complex digital AM receiver.
3. Assuming the channel adds white noise and that a b-bit A/D converter is used, what is the output's signal-to-noise ratio?

Problem 5.30: DFTs

A problem on Samantha's homework asks for the **8-point** DFT of the discrete-time signal $\delta(n-1) + \delta(n-7)$.

1. What answer should Samantha obtain?
2. As a check, her group partner Sammy says that he computed the inverse DFT of her answer and got $\delta(n+1) + \delta(n-1)$. Does Sammy's result mean that Samantha's answer is wrong?
3. The homework problem says to lowpass-filter the sequence by multiplying its DFT by

$$H(k) = \begin{cases} 1 \; if \; k = \{0, 1, 7\} \\ 0 \; otherwise \end{cases}$$

and then computing the inverse DFT. Will this filtering algorithm work? If so, find the filtered output; if not, why not?

Problem 5.31: Stock Market Data Processing

Because a trading week lasts five days, stock markets frequently compute running averages each day over the previous five trading days to smooth price fluctuations. The technical stock analyst at the Buy-Lo Sell-Hi brokerage firm has heard that FFT filtering techniques work better than any others (in terms of producing more accurate averages).

1. What is the diference equation governing the fve-day averager for daily stock prices?
2. Design an efcient FFT-based filtering algorithm for the broker. How much data should be processed at once to produce an efcient algorithm? What length transform should be used?